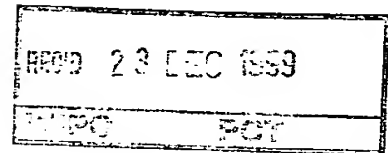




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I, KAY WARD, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PP 6711 for a patent by BRUCE WILSON SERVICES PTY. LIMITED filed on 23 October 1998.



WITNESS my hand this  
Eighth day of December 1999

KAY WARD  
TEAM LEADER EXAMINATION  
SUPPORT AND SALES

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**BRUCE WILSON SERVICES PTY, LIMITED**

AUSTRALIA  
Patents Act 1990

**PROVISIONAL SPECIFICATION FOR THE INVENTION ENTITLED:**

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**DETECTION OF REFRIGERANT LEAKS**

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The invention is described in the following statement:

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**AUSTRALIA**

Patents Act 1990

**PROVISIONAL SPECIFICATION**

Invention Title: "DETECTION OF REFRIGERANT LEAKS"

The invention is described in the following statement:

This invention relates to the repair and servicing of refrigeration systems. The invention is directed towards locating refrigerant leaks from refrigerators and refrigeration systems using refrigerant substances, other than those chlorofluorocarbons (CFCs) that ~~have been banned under the Montreal Protocol, as the refrigerant.~~

The invention is applicable quite generally to such equipment, but was developed primarily for use in relation to vehicle air conditioning systems and is described primarily with reference thereto hereinafter.

Vehicle air conditioning systems are prone to developing minor refrigerant leaks from small fatigue cracks and loose pipe connections brought about by the vibration that the systems are subjected to in use. The detection and location of the leaks is rendered difficult because the refrigerants in question are normally odorless and colourless.

Thus it has become commonplace for diagnostic compositions containing dyes which fluoresce under the influence of ultra-violet radiation to be used to make the leaks obvious. Hitherto it has been usual when servicing a leaky system to charge the system with a small quantity of the dye-containing composition, then if no gas was left in system to add gas as well. Then, run the system to cause leakage of the composition with the gas

and then detect the leak by detecting the residues of dye left on the surface of the system components at the site of the leak.

It will be apparent from the foregoing that the rectification of leaks has been a laborious, lengthy process requiring the use of special equipment. It has also been disadvantageous for the service provider in that there is always the possibility of accidental spillage of the diagnostic composition causing discolouration of the customer's vehicle and service equipment requiring elaborate clean up procedures.

An object of the present invention is provide a commercially attractive alternative to the above described service procedures. The invention is based on the discovery that small but effective quantities of the previously used diagnostic compositions may remain permanently in suspension or solution in the liquid refrigerant when stored in cylinders long term. This pre-mixture of the two allows for simplified introduction of dye composition when gas is introduced into the system.

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The invention is based on the further discovery that if a quantity of the diagnostic composition is mixed into the liquid refrigerant prior to the system being charged therewith, sufficient dyestuff will attach to the system's lubricating oil to be carried to leaks occurring in parts of the system normally containing only refrigerant vapour for those leaks to be made apparent by dye residues from escaping oil at such a leak.

Conventionally refrigerant is supplied by refrigerant wholesalers to service persons and refrigeration equipment manufacturers in pressure vessels able to withstand the vapour pressure of the refrigerant at normal ambient temperatures. Those pressure vessels are commonly referred to simply as "gas cylinders", notwithstanding that a normally full said gas cylinder is very nearly full of liquid refrigerant in equilibrium with only a relatively small ullage volume of refrigerant vapour. Each said gas cylinder is fitted with a manually operable outlet valve including a standardised hose connector, whereby the cylinder may be connected to standardised manually operable inlet valves, also furnished with standardised hose connectors, for the admission of refrigerant into both the liquid filled high pressure and vapour filled low pressure parts of the system,

The present invention contemplates that a wholesaler or manufacturer may incorporate an effective amount of dye stuff into the refrigerant while filling the said gas cylinders for delivery to the system manufacturer or service provider, to enable the latter persons to charge the system with refrigerant in a normal manner, to thereafter render it unnecessary for a service provider to add the dye composition separately when placing gas in a system or adopt special procedures to detect leaks.

Thus, in its broadest form the invention consists in a said gas cylinder containing an admixture of liquid refrigerant and an effective amount of a diagnostic dye suited to mixing with gas and oil not just oil.

In experiments leading to the present invention it was found that if a conventional diagnostic composition is injected into an already filled cylinder

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the dye is likely to form a precipitate which will not thereafter re-mix with the liquid refrigerant; but that this could be overcome by injecting a dye containing composition into ~~the liquid refrigerant at a slow and controlled rate as it is piped into the gas cylinder or~~ back to bulk storage by the wholesaler or other filler thereof. It is thought that this is effective because it limits the localised concentration of dye composition in the liquid refrigerant at any one time.

Thus, the invention further consists in a method of filling a gas cylinder with an admixture of liquid refrigerant and an effective amount of a diagnostic dye, comprising the step of continuously injecting a minor flow of a dye into a filler pipe through which a major flow of liquid refrigerant is being fed into a cylinder being filled. The dye may be fed into the filler pipe by any form of positive displacement pump running at an appropriate speed to deliver the dye against the pumping and vapour pressure of the refrigerant at the temperature in the pipe.

The above described method of the invention is applicable to the filling of present day gas cylinders. In a less preferred alternative using a special gas cylinder with an

auxiliary filling valve the dye may be injected directly into the liquid pool in the cylinder simultaneously with the input of refrigerant through the conventional valve.

As a general rule, the pigments in dyes that are currently used as diagnostic agents are essentially solids made available as powders. Before they can be readily pumped they require to be dissolved in an appropriate liquid solvent. Indeed they are currently marketed as solutions containing about 2% by weight of pigment in a liquid solvent. Therefore the term "dye" as used herein includes within its ambit liquid solutions of the pigment material.

Furthermore, in preferred embodiments the dye is preferably delivered in a dye composition comprising such liquid solutions of pigment, preferably a pigment that fluoresces under the influence of ultra-violet radiation, in admixture with one or more of the following — mineral oils — vegetable oils — surfactants — synthetic oils — esters.

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Thus a preferred composition for inclusion in the liquid refrigerant may comprise dye solution containing about 2% by weight of pigment dissolved in an admixture of a combination of the chemicals described above. These chemicals have been found to reduce or stop the forming of the precipitate previously mentioned.

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Dated this 23<sup>rd</sup> day of October 1998

BRUCE WILSON SERVICES PTY. LIMITED

BY: 

Patent Attorney for the Applicant